
स्वचल वाहन — ब्रेक प्रणाली,
व्हील सिलिंडरों के लिए रबड़
के बूट — कार्यकारिता अपेक्षाएं
(पहला पुनरीक्षण)

**Automotive Vehicles —
Braking Systems, Rubber Boots
for Brake Wheel Cylinders —
Performance Requirements**
(*First Revision*)

ICS 43.040.40; 83.140.01

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FOREWORD

This Indian Standard (First Revision) was adopted by Bureau of Indian Standards, after the draft finalized by the Automotive Braking and Steering Systems, Vehicle Testing and Performance Evaluation Sectional Committee, had been approved by the Transport Engineering Division Council.

Rubber boot is one of the critical components of the hydraulic brake systems. This standard was first published in 1990. The revision of this standard has been taken up to update the standard with latest technological developments.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

AUTOMOTIVE VEHICLES — BRAKING SYSTEMS, RUBBER BOOTS FOR BRAKE WHEEL CYLINDERS — PERFORMANCE REQUIREMENTS

(*First Revision*)

1 SCOPE

This standard specifies the performance requirements and test methods for rubber boots at the end of wheel cylinders (used in drum brakes) to prevent the entrance of impurities like dirt and moisture.

2 REFERENCES

The following standards contain provisions, which through reference in this text, constitute provisions of this standard. At the time of publication the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below.

<i>IS No.</i>	<i>Title</i>
3400	Methods of test for vulcanized rubbers
(Part 1) : 1987	Tensile stress-strain properties (<i>second revision</i>)
(Part 2) : 2003	Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD) (<i>third revision</i>)
(Part 4) : 1987	Accelerated ageing (<i>second revision</i>)
(Part 6) : 2005	Resistance to liquids (<i>second revision</i>)
(Part 7) : 1985	Resistance to flex-cracking (<i>first revision</i>)
(Part 10) : 1977	Compression set at constant strain (<i>first revision</i>)
(Part 20) : 1994	Resistance to ozone cracking — Static strain test (<i>first revision</i>)
8654 : 2001	Automotive hydraulic brake fluid, heavy duty — Specification (<i>second revision</i>)

3 CLASSIFICATIONS

The rubber boots intended for operation is classified according to the performance required at varied temperatures are given in Table 1.

Table 1 Classification of Rubber Boots

(*Clause 3*)

Sl No.	Division	Symbol	Performance
(1)	(2)	(3)	(4)
i)	Class 1	—	Suitable for operation at ordinary temperature
ii)	Class 2	H	Suitable for operation at a high temperature
iii)	Class 3	S	Suitable for operation at an extra high temperature

4 REQUIREMENTS

4.1 General Requirements

There shall be no cracks, blisters, pin-holes, swelling, embedded foreign material on the boot surface or any other physical defects.

4.2 Material

The material used for the boot shall conform to the requirements as specified in Table 2.

4.3 Performance Requirements

The performance of the boots shall conform to the requirements as specified in Table 3.

5 MARKING

5.1 Each rubber boot shall be marked with the following:

- a) Manufacture's name, initial or trade-mark;
- b) Identification of mould (cavity number); and
- c) Class (*see 3*).

5.1.1 Date of packing or control unit number.

5.2 BIS Certification Marking

The rubber boots may also be marked with BIS Standard Mark.

5.2.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder.

The details of conditions under which the license for the use of Standard Mark may be granted to the manufacturers or producers may be obtained from the Bureau of Indian Standards.

Table 2 Material Properties

(Clause 4.2)

SI No. (1)	Properties (2)		Units (3)	Classification			Method of Test, Ref to (7)
				Class 1 (4)	Class 2 (5)	Class 3 (6)	
i)	Ordinary state	Hardness	IRHD	50 ± 5 or 60 ± 5			IS 3400 (Part 2)
		Tensile strength	MPa	10, <i>Min</i>	10, <i>Min</i>	8, <i>Min</i>	IS 3400 (Part 1)
		Elongation	Percent	300, <i>Min</i>			
ii)	Ageing Resistance	Temperature	°C	100 ± 2	120 ± 2	150 ± 2	IS 3400 (Part 4)
		Duration	h	70 ± 2			
		Hardness change	IRHD	- 0 to +10			
		Tensile strength change rate (reduction rate)	Percent	40, <i>Max</i>			
		Elongation change rate (reduction rate)	Percent	40, <i>Max</i>			
iii)	Compression permanent set	Temperature	°C	100 ± 2	120 ± 2	150 ± 2	IS 3400 (Part 10)
		Duration	H	22 ± 1			
		Compression set	Percent	30, <i>Max</i>	40, <i>Max</i>	55, <i>Max</i>	
iv)	Fluid resistance test	Temperature	°C	100 ± 2	120 ± 2	150 ± 2	IS 3400 (Part 6)
		Duration	H	70 ± 1			
		Volume change rate	Percent	-15 – + 15		-20 – +15	
		Hardness change	IRHD	-10 to +10			
		Tensile strength change rate (reduction rate)	Percent	40, <i>Max</i>			
		Elongation change rate (reduction rate)	Percent	40, <i>Max</i>			
v)	Low temperature flexibility	Temperature	°C	-43 to -40			IS 3400 (Part 7)
		Duration	h	22 ± 1			
		State		No cracking			
vi)	Ozone resistance	Ozone concentration	PPHM	50 ± 5			IS 3400 (Part 20)
		Temperature	°C	40 ± 2			
		Duration	h	70 ± 2			
		Strain (static)	Percent	20 ⁺⁰ ₋₃			
		State		No cracking discernible with 2X magnification			

Table 3 Performance Requirements*(Clause 4.3)*

Sl No.	Properties		Units	Classification			Method of Test, Ref to
				Class 1	Class 2	Class 3	
(1)	(2)		(3)	(4)	(5)	(6)	(7)
i)	Ordinary state	Hardness (Informative)	IRHD	50 ± 5 or 60 ± 5			IS 3400 (Part 2)
ii)	Tension set property	Temperature	°C	100 ± 2	120 ± 2	150 ± 2	Annex A
		Duration	h	70 ± 2			
		Pre-stretch	Percent	15 ⁺⁰ ₋₃			
		Tension	Percent	75, <i>Max</i>			
iii)	Ageing Resistance	Temperature	°C	100 ± 2	120 ± 2	150 ± 2	Annex B
		Duration	h	70 ± 2 (However 22 ± 1 h are permitted according to the agreement between the parties concerned with delivery)			
		Hardness change	IRHD	- 5 to +10			
		State of boot		After testing, no cracking shall generate when the boot is flexed to service condition. Further no visible tackiness shall be evident			
iv)	Stroking durability	Temperature	°C	100 ± 2 (fluid temperature) or 100 ± 5 (Atmosphere temperature)	120 ± 2 (fluid temperature) or 120 ± 5 (Atmosphere temperature)	150 ± 2 (fluid temperature) or 150 ± 5 (Atmosphere temperature)	Annex C
		Duration	h	70 ± 2 (However 22 ± 1 h are permitted according to the agreement between the parties concerned with delivery)			
		State of boot		After testing, the boot shall be free from blisters and peelings and shall not separate from its assembled piston, cylinder and the like			
v)	Fluid resistance test	Temperature	°C	100 ± 2	120 ± 2	150 ± 2	Annex D
		Duration	h	70 ± 2			
		Volume change rate	Percent	- 15 to +15		-20 to +15	
		Hardness change	IRHD	-10 to +10			
		State of boot		After testing, the boot shall be free from tackiness and abnormal appearance			
vi)	Low temperature stroking durability and low temperature bend test	Temperature	°C	-43 to -40			Annex E and Annex F
		Duration	h	22 ± 1(However 70 ± 1 h are permitted according to the agreement between the parties concerned with delivery)			
		State of boot		During testing, the boot shall be free from generating cracking or not separate from its assembled piston, cylinder and the like			
vii)	Ozone resistance	Ozone concentration	PPHM	50 ± 5			Annex G
		Temperature	°C	40 ± 2			
		Duration	h	70 ± 2			
		Strain (static)	Percent	15 ⁺⁰ ₋₃			
		State of boot		The boot surface shall not show evidence of cracking under 2X magnification			

ANNEX A*(Table 3)***TENSION SET TEST****A-1 TEST SPECIMEN**

Three boots are taken as test specimen.

A-2 TEST PROCEDURE

A mandrel is made, to suit the sealing and attached to wheel cylinder or to the actuating push rod / piston, such that the diameter is 115 percent of the moulded diameter of the chosen boot end. This means that when the test boot is mounted on to the mandrel, it will expand the chosen boot end by 15 percent. The moulded diameter shall be calculated from the average of two measurements made at the right angles to each other. The mandrel shall be provided with a smooth lead-in chamfer to prevent cutting of the rubber and shall itself have a polished machine finish (0.4 µm in AA maximum).

Measure the inside diameter of the ends of 3 specimen boots to nearest 0.02 mm. Measure at two positions at right angles to each other and take the mean value.

Assemble the test boots on the stretch mandrels. Place assemblies in oven and test to be conducted as per conditions specified in Table 2.

At the end of the heat exposure, remove the assemblies and cool at room temperature. Take the boots off the mandrel and allow recovering for 1 h. Again measure the diameter and record.

A-3 CALCULATION

Tension set is calculated as percentage of the original stretch deflection as per the following:

$$\text{Tension set} = \frac{(D_2 - D_3) \times 100}{(D_3 - D_1)}$$

where

D_1 = diameter before test, mm

D_2 = diameter after the test, mm; and

D_3 = mandrel diameter, mm

NOTE — Minimum 3 specimens shall be tested in the above manner.

ANNEX B*(Table 3)***HEAT RESISTENCE TEST — STATIC****B-1 TEST SPECIMEN**

Two boots shall be taken as test specimen.

B-2 TEST PROCEDURE

Determine the initial hardness using the shore harness

tester. Place the specimen in the oven. Test to be conducted as per Table 3.

At the end of the heat exposure remove them from the oven, allow to cool to room temperature and then check the hardness and flexibility.

ANNEX C*(Table 3)***HEAT STROKING TEST****C-1 TEST SPECIMEN**

Two boots with corresponding wheel cylinder shall be taken as test specimen.

C-2 TEST PROCEDURE

Assemble the wheel cylinder and boots taking the normal precautions and then mount the cylinder into the actuator assembly, operating at $1\,000 \pm 100$ strokes/h with a stroke length of 4.8 ± 0.5 mm. A typical

set up for actuation is shown in Fig. 1.

Place the cylinder assembly with the test boots in the oven and actuate for duration at temperature as specified in Table 3. The brake fluid used shall conform to IS 8654.

After the actuation of the assembly it shall be removed from oven, allowed to cool to room temperature and the boots examined for flex, cracks and general appearance.

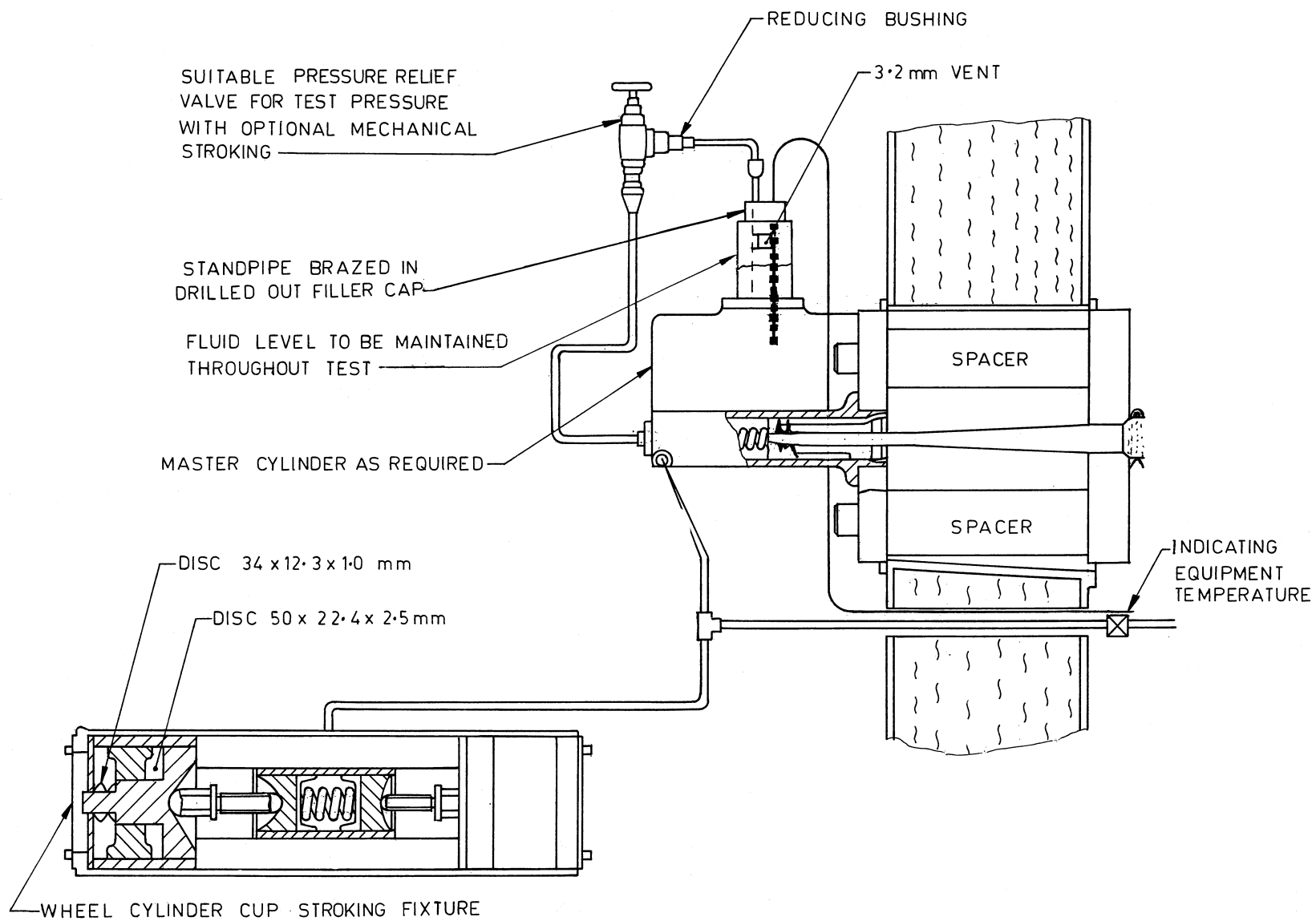


FIG. 1 TYPICAL ACTUATOR FOR HEAT STROKING TEST

ANNEX D*(Table 3)***RESISTANCE TO FLUIDS AT ELEVATED TEMPERATURE****D-1 TEST SPECIMEN**

Test specimen shall be two pieces weighing approximately 3 to 5 g from each of boots. For the boot not exceeding 5g in mass, two products shall be used as specimen.

D-2 TEST PROCEDURE

D-2.1 Determine and record initial volume of each seal by finding out the difference between the weight in air and weight in water.

D-2.2 Determine and record initial IRHD hardness of the test seals using a micro tester.

D-2.3 Test specimens shall be completely immersed in 75cc of brake fluid conforming to IS 8654 or any higher grade as recommended by the vehicle manufacturer in a glass jar and tightly capped. The jar shall be placed in an oven as per condition specified in Table 3. A typical set up for test container for liquid resistance test is shown in Fig. 2

At the end of the heating period, allow the test specimens to cool in the glass jar to ambient conditions for 60 to 90 min and then rinsed with isopropyl alcohol or ethyl alcohol and wipe dry. Specimens shall not remain in the alcohol for more than 30s. Determine and record the fluid volume and hardness (IRHD) of each specimen. Examine the specimens for disintegration as evidenced by blisters or sloughing.

D-3 CALCULATION

D-3.1 The change in volume 'V' in percentage is obtained from the equation :

$$V = \frac{\{(W_3 \times W_4) \times (W_1 \times W_2)\} \times 100}{(W_2 - W_3)}$$

where

V = change in volume, percent;

W₁ = mass in air before dipping, g;

W₂ = mass in water before dipping, g;

W₃ = mass in air after dipping, g; and

W₄ = mass in water after dipping, g.

D-3.2 The hardness change shall be calculated as according to the following formula:

$$\Delta H = H_2 - H_1$$

where

ΔH = hardness change;

H₁ = hardness before test; and

H₂ = hardness after test.

NOTES

1 Determination and observations prescribed in **D-3.1** and **D-3.2** shall be made within 60 min of cleaning with alcohol after completion of immersion test.

2 The tests **D-3.1** and **D-3.2** may be made on same specimen.

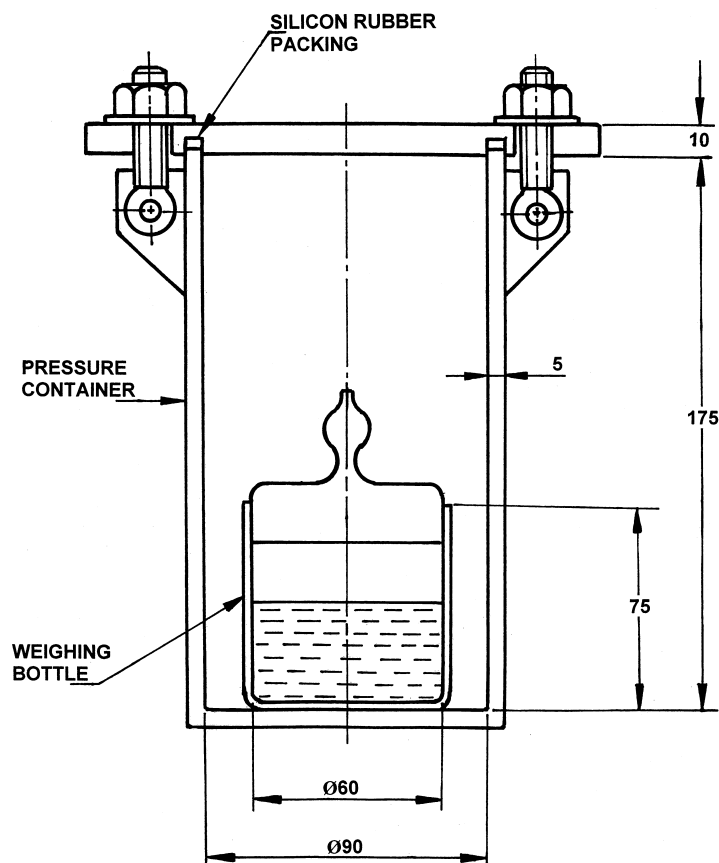


FIG. 2 TEST CONTAINER FOR LIQUID RESISTANCE (EXAMPLE)

ANNEX E

(Table 3)

LOW TEMPERATURE STROKING TEST

E-1 TEST SPECIMEN

Two boots with corresponding wheel cylinder shall be taken as test specimen.

E-2 TEST PROCEDURE

Assemble the wheel cylinder and boots taking the normal precautions and mount the same into the actuator assembly. A typical actuator is shown in Fig. 3.

Place the wheel cylinder assembly with the test boots in a cold chamber which is sufficient to contain them and so arranged to permit the operator to check and operate it without removal from the chamber, thus

exposing the specimen at a temperature for duration as specified in Table 3.

After the exposure for the period specified, stroke the boots with the stroking apparatus having stroke length 4.8 ± 0.5 mm for 6 strokes at intervals of 30 s without removal from the chamber. The brake fluid used shall be as per IS 8654 or that agreed between the parties concerned with delivery

After the test, the wheel cylinder assembly is taken from the cold chamber and checked. The boot shall not reveal any crack in the assembled position of the cylinder or become loose on the push rod.

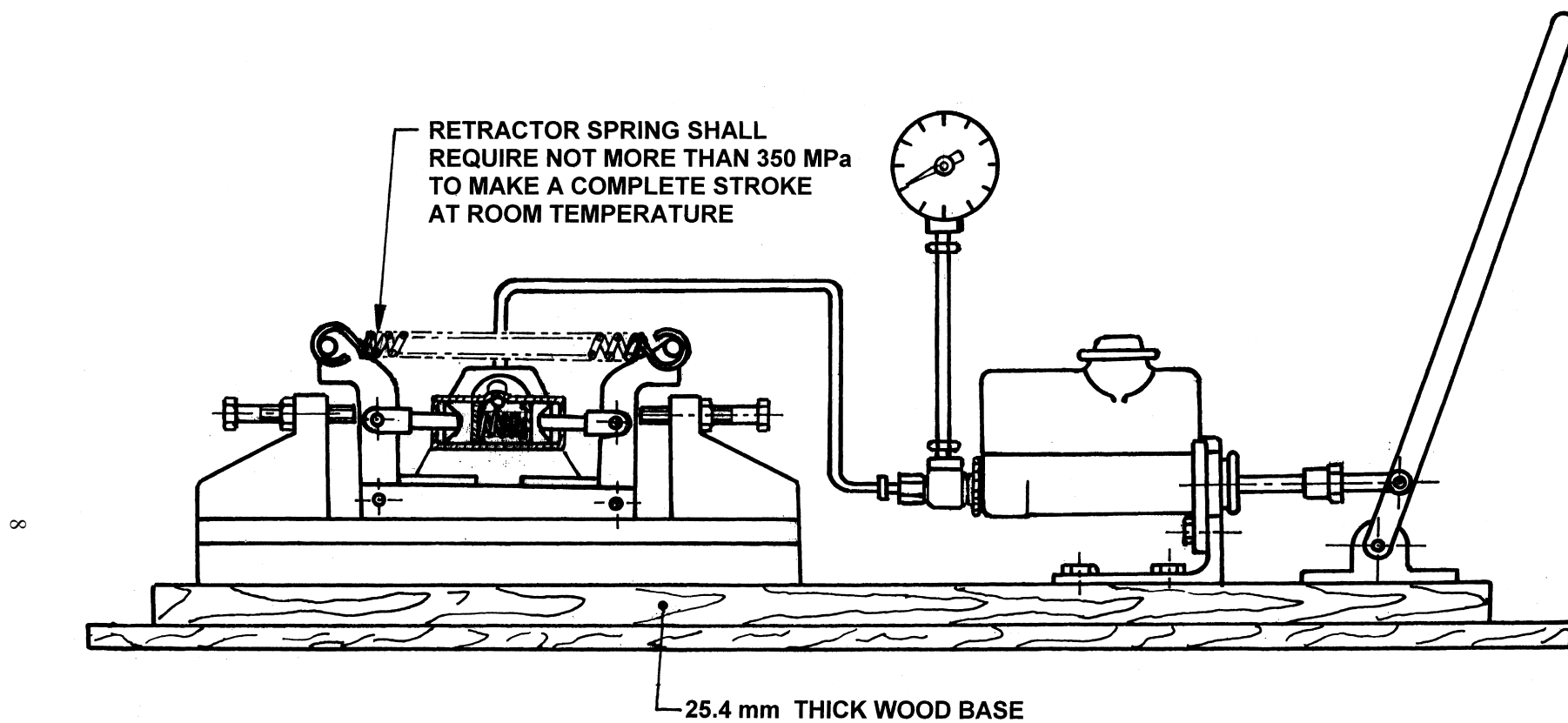


FIG. 3 LOW TEMPERATURE LEAKAGE TEST APPARATUS

ANNEX F*(Table 3)***LOW TEMPERATURE – BEND TEST****F-1 TEST SPECIMEN**

Three boots shall be taken as test specimens

F-2 TEST PROCEDURE

Place the boot in a cold chamber at -40°C to -43°C

for 70 ± 2 h. At the end of the test, bend the boot between thumb and finger inside the chamber and immediately release. Check the condition when it returns to its original shape. Returning the boot to room temperature, check for cracks. Use gloves for bending to avoid conduction of body heat.

ANNEX G*(Table 3)***OZONE RESISTANCE TEST****G-1 TEST SPECIMEN**

Two boots shall be taken as test specimen.

G-2 TEST PROCEDURE

A stretching mandrel as given in Annex A is also made available for carrying out the test.

Assemble the boots on the stretching mandrel and allow resting for 22 ± 2 h at room temperature. Then subject the boots installed on the mandrels to an ozone concentration in the ozone chamber as per Table 3. At

the end of the exposure, the boot surface shall be free from cracks under 2X magnification

NOTE — Figures 4 and 5 provide typical arrangement for ozone cracking chamber. However, an acceptable ozone chamber is one that has sufficient air-ozone throughput rate, internal circulation and volume. The volume of the chamber shall at least be 0.11 to 0.14 m^3 . It is also recommended that the generating source is kept outside the chamber with filtration of foreign matter from the strainer. The recommended partial pressure of ozone shall be approximately 50 mPa . The air-ozone velocity can be 0.6 m/s . The normal source of ozone is the mercury vapour lamp.

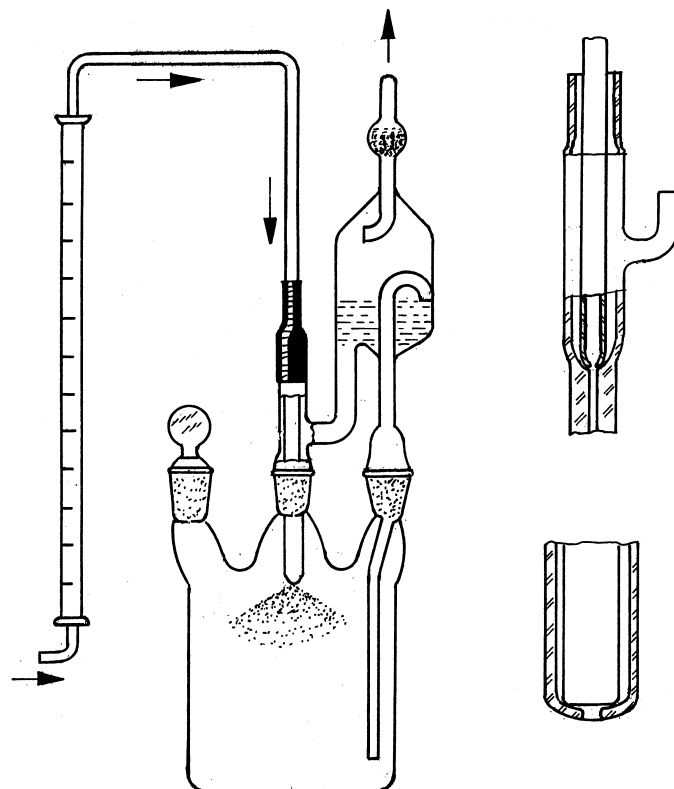


FIG. 4 OZONE ABSORBING DEVICE (TYPICAL) (SPRAY JET)

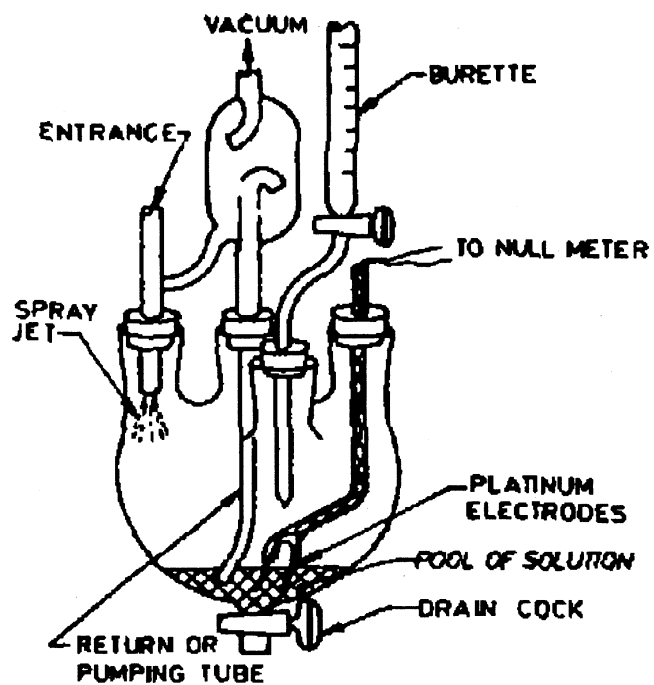


FIG. 5 MODIFIED SPRAY-JET APPARATUS

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Amendments Issued Since Publication

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